AbstractID: 9309 Title: Characterization of gold nanoshells for thermal therapy using MRI

Purpose: To investigate the development of light activated gold nanoshells as mediators for highly conformal photothermal therapy of soft-tissue tumors with an emphasis on illustrating how results from MR-guidance in phantoms, *in vivo* small and large animals have helped demonstrate feasibility and shape the therapeutic approach. **Method and Materials:** Experiments were performed on a 1.5T MRI. Temperature was measured in real-time using MR thermography based on the proton resonance frequency shift. Nanoshell phantoms were employed to evaluate effects of concentration and size on distribution of heat when activated by an 808-nm laser and quantitatively correlated to a 3D finite element model. Passive (enhanced permeability and retention) and active (EGFR receptor) targeting was studied in tumor xenografts. Feasibility of interstitial therapy delivery was investigated in a large animal model of brain cancer using a canine sarcoma model. **Results:** Numerical modeling of heating of gold-silica nanoshells in phantom correlated excellently with observed MR measured heating patterns. SEM results indicate that passive accumulation of nanoshells (~140 nm) results in large concentrations near tumor microvasculature (corroborated by MR heating and dynamic enhancement patterns) and this results in statistically significant increase in temperature (21 ± 4ºC) over controls after 3 minutes at 4 W/cm^2 in a PC3 xenograph. Intravenous injection of these nanoshells into a dog model of cancer resulted in selective heating of the target tumor observable on MRI. EGFR receptor targeting allowed increased uptake of smaller nanoshells (<30 nm) versus non-targeted nanoshells. Addition of iron-oxide cores facilitated MR imaging of nanoshells in addition to heating. **Conclusion:** Gold nanoshells effect a more conformal thermal therapy delivery, as confirmed in a large animal model of brain cancer. MR temperature imaging and guidance is an invaluable tool in the investigation and development of this emerging thermal therapy technique as it moves from Petri dish to patient.